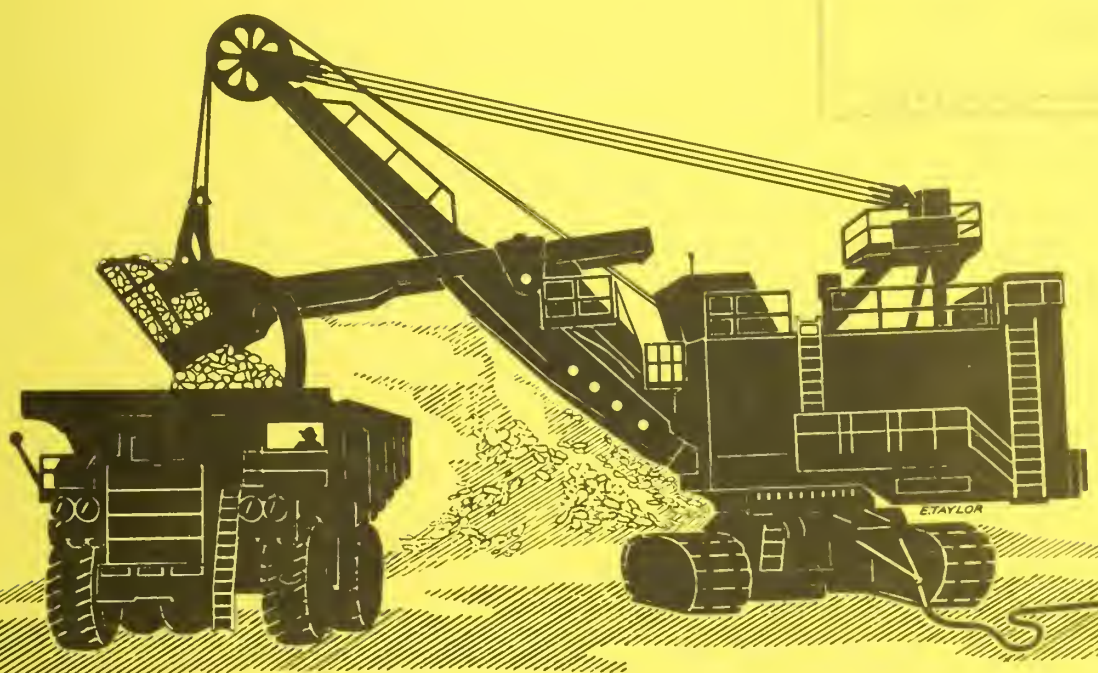


MINERAL COMMODITY REPORT

--PUMICE AND PUMICITE--

1985



CALIFORNIA DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY



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JAMES F. DAVIS
STATE GEOLOGIST

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MINERAL COMMODITY REPORT

--PUMICE AND PUMICITE--

1985

By

JOHN L. BURNETT


Part 1 from
the U.S. Bureau of Mines publication,
Mineral Commodity Summaries, 1986

CALIFORNIA DEPARTMENT OF CONSERVATION

DIVISION OF MINES AND GEOLOGY

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INTRODUCTION

This report on the availability and demand for pumice, pumicite, perlite, and volcanic cinder in California, the United States, and the world is one in a series of Mineral Commodity Reports prepared by the Department of Conservation, Division of Mines and Geology (DMG) to describe commodities of significance to California and the nation.

This mineral commodity report was compiled by John L. Burnett of the DMG geologic staff. Part I consists of United States and world-wide mineral statistic information and economic analysis adopted directly from the U.S. Bureau of Mines "Mineral Commodity Summaries, 1986." Part II discusses production of the commodity in California. The U.S. Bureau of Mines presents the earliest Government estimates of non-fuel mineral-industry data, including world resource data provided by the U.S. Geological Survey.

Pumice, pumicite, perlite and volcanic cinder are glassy volcanic rocks. Pumice, pumicite, and perlite are volcanic glasses formed during the rapid chilling of rhyolitic to intermediate magmas. Volcanic cinders are red-to-black materials that range in composition from dacite through andesite and basalt, and contain an abundance of gas bubbles.

Commercial deposits of pumice, pumicite, perlite and volcanic cinder occur worldwide in areas that have experienced volcanic eruptions during the Cenozoic Era, the last 63 million years. In California, production has been centered near the Los Angeles and San Francisco Bay areas with lesser production in northeastern and eastern California.

In 1985, approximately 33 percent of the 830,000 short tons of pumice and pumicite utilized in the United States was imported from foreign sources, principally Greece (96%). United States production was 556,000 short tons coming from 21 producers in eight states. California led all producing States with eight active operations. The major uses of pumice and pumicite were in concrete aggregate and building block, about 88% of apparent consumption.

For further information, please call (916) 445-5716, the DMG centralized information number.

PART I: UNITED STATES AND WORLDWIDE
(Data in thousand short tons, unless noted)

1. UNITED STATES PRODUCTION AND USE

The estimated value of pumice and pumicite sold or used in 1985 was \$5.1 million. Domestic output came from 21 producers in eight states. The principal producing states were California, Idaho, New Mexico, and Oregon; their combined production accounted for about 95% of the national total. California led all producing states with eight active operations. The major uses of pumice and pumicite were in concrete aggregate and building block, about 88% of apparent consumption.

2. SALIENT STATISTICS--UNITED STATES

	1981	1982	1983	1984	1985 ^e
Production: Mine ¹	499	416	449	502	556
Imports for consumption	92	121	184	293	275
Exports ^e	1	1	1	1	1
Consumption, apparent	590	536	632	794	830
Price: Average value, dollars per ton, f.o.b. mine or mill	8.64	9.01	9.99	9.82	9.00
Stocks yearend		N o t a v a i l a b l e			
Employment: Mine and mill	60	60	60	60	60
Net import reliance ² as a percent of apparent consumption	15	22	29	37	33

3. RECYCLING

None

4. IMPORT SOURCES (1980-83)

Greece 96%, Other 4%.

^e Estimated. NA Not available, N.s.p.f. Not specifically provided for.
¹ Quantity sold or used by producers.
² Defined as imports - exports + adjustments for Government and industry stock changes.

5. TARIFF

<u>Item</u>	<u>Number</u>	<u>Most Favored Nation (MFN)</u>		<u>Non-MFN</u>
		<u>1/1/86</u>	<u>1/1/87</u>	<u>1/1/86</u>
Used in the manufacture of masonry products such as building blocks, bricks, tiles, and similar forms	519.05	Free	Free	Free
Crude or crushed:				
Valued not over \$15 per ton	519.11	0.01¢/lb	0.01¢/lb	0.1¢/lb
Valued over \$15 per ton	519.14	0.035¢/lb	0.035¢/lb	0.25¢/lb
In grains or ground, pulverized or refined	519.31	0.13¢/lb	0.13¢/lb	0.75¢/lb
Millstones, abrasive wheels, and abrasive articles, n.s.p.f.	519.93	5.0¢ ad val.	4.7% ad val.	35% ad val.
Articles, n.s.p.f.	523.61	3.3% ad val.	2.8% ad val.	35% ad val.

6. DEPLETION ALLOWANCE

5% (Domestic), 5% (Foreign).

7. GOVERNMENT STOCKPILE

None

8. EVENTS, TRENDS, AND ISSUES

From a 1983 base, demand for pumice and pumicite is expected to increase at an average annual rate of about 2% through 1990. Domestic reserves of pumice are expected to adequately supply domestic demand. Changing geographic demand patterns coupled with increasing transportation costs and lack of detailed reserve information could create problems for selecting new production locations. It is estimated that in 1986 domestic mine production of pumice and pumicite will be 570,000 tons and U.S. apparent consumption will be 850,000 tons.

All domestic mining of pumice in 1985 was by open pit methods and generally occurred in relatively remote areas where land use conflicts were not severe. Although the generation and disposal of reject fines in mining and milling resulted in a dust problem at some operations, the environmental impact was restricted to a small geographical area.

9. WORLD MINE PRODUCTION AND RESERVE BASE

	<u>Production</u>		<u>Reserve Base³</u>
	<u>1984</u>	<u>1985^e</u>	
United States	502	556	Large
France	660	650	NA
Germany, Federal Republic of	290	300	NA
Greece	2,370	2,400	NA
Italy	6,820	6,800	NA
Other Market Economy Countries	2,750	2,800	NA
Centrally Planned Economies	NA	NA	NA
World Total ⁴ (rounded)	<u>13,400</u>	<u>13,500</u>	<u>NA</u>

10. WORLD RESOURCES

The domestic identified resources of pumice and pumicite in the West are estimated to be at least 25 million tons. The estimated resources in the Western and Great Plains States are 250 million to 450 million tons.

11. SUBSTITUTES

Transportation cost determines the maximum distance that pumice and pumicite can be shipped and remain competitive with alternate materials. Alternate competitive materials that can be substituted for pumice and pumicite for several end uses include expanded shale and clay, diatomite, and crushed aggregates.

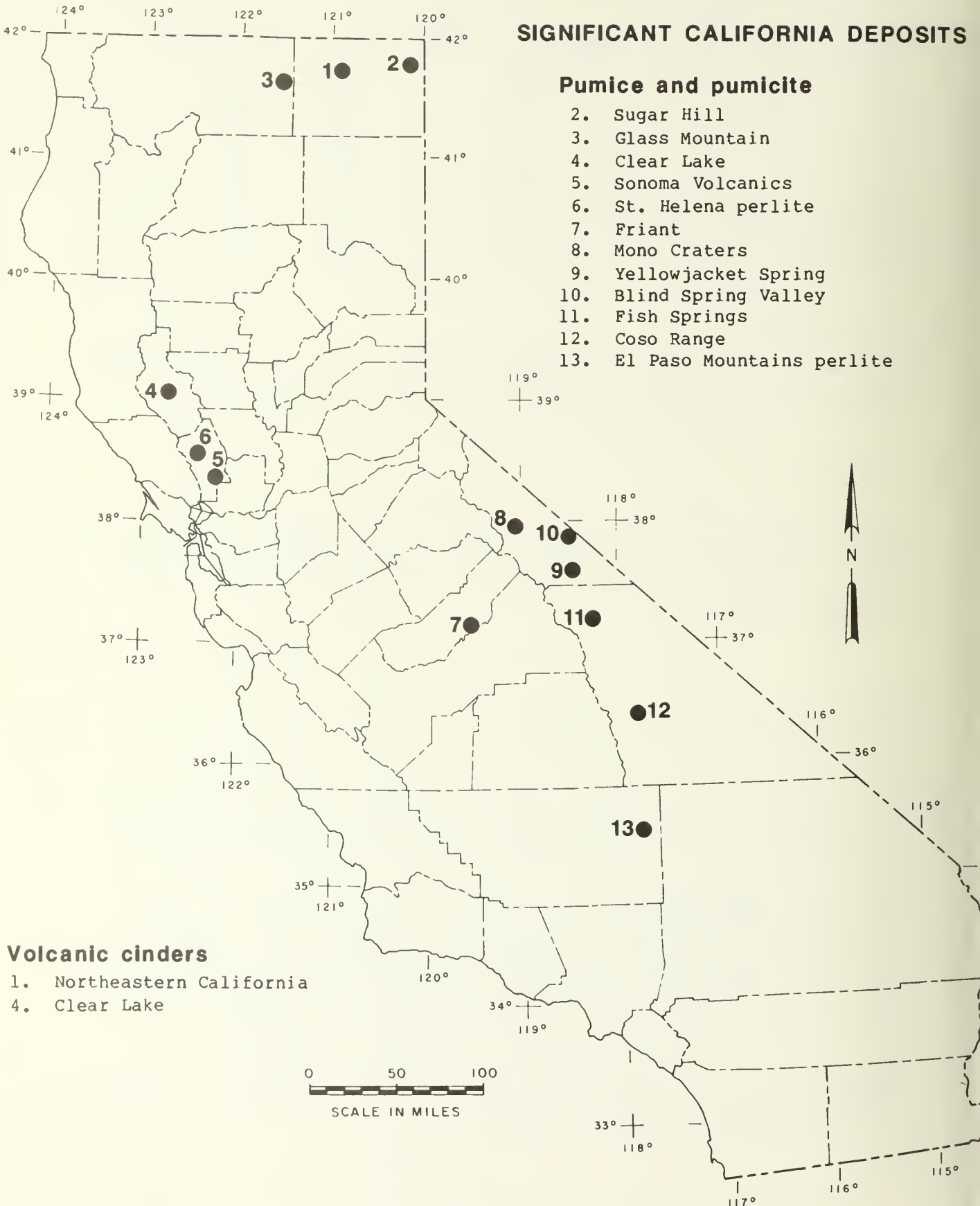
^e
³ Estimated. NA Not available, N.s.p.f. Not specifically provided for. Reserve Base. That part of an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality, thickness, and depth. The reserve base is the in-place demonstrated (measured plus indicated) resource from which reserves are estimated. It may encompass those parts of the resources that have a reasonable potential for becoming economically available within planning horizons beyond those that assume proven technology and current economics. The reserve base includes those resources that are currently economic (reserves), and some of those that are currently subeconomic (subeconomic resources). The term "geologic reserve" has been applied by others generally to the reserve-base category, but it also may include the inferred-reserve-base category; it is not a part of this classification system.

⁴ Excluding Centrally Planned Economies.

SIGNIFICANT CALIFORNIA DEPOSITS

Pumice and pumicite

2. Sugar Hill
3. Glass Mountain
4. Clear Lake
5. Sonoma Volcanics
6. St. Helena perlite
7. Friant
8. Mono Craters
9. Yellowjacket Spring
10. Blind Spring Valley
11. Fish Springs
12. Coso Range
13. El Paso Mountains perlite



Volcanic cinders

1. Northeastern California
4. Clear Lake

PART II: CALIFORNIA

12. CALIFORNIA GEOLOGICAL OCCURRENCES

Pumice, pumicite, and perlite are volcanic glasses formed during the rapid chilling of rhyolitic to intermediate magmas. Pumice is an obsidian glass which contains so many bubbles that the rock often will float in water. Pumicite is volcanic ash formed by the explosive eruption of a volcano. When these small particles fall to the ground, massive deposits of slightly to well-cemented, light-weight rock is formed. Perlite is formed by rapidly chilling an obsidian, shattering the rock, and introducing up to 12% water. Volcanic cinders are red-to-black materials that range in composition from dacite through andesite and basalt that contain an abundance of gas bubbles.

California is richly endowed with all of these rocks, so much so that the cost of transporting the material to its market becomes a critical factor in determining which deposits can be economically used. Since southern California contains the bulk of the State's population, deposits near the perimeter of Los Angeles tend to have the best economic potential. Other deposits near the San Francisco Bay Area-Sacramento market are economically usable as well as deposits in eastern California located near inexpensive rail haulage. Finally, isolated areas, such as Modoc County, may consume modest quantities of volcanic cinders for use in local road building and maintenance.

13. CALIFORNIA LOCALITIES

1. Northeastern California Volcanic Cinders:

Modoc, Lassen, eastern Shasta, and eastern Siskiyou counties have produced large quantities of volcanic cinders. Approximately 20 quarries have produced over 5 million tons of cinders since large-scale quarrying began in the 1930s. The sources are Pleistocene and Recent cinder cones. Most of the material was used as railroad ballast in track construction, but more recently, the material has gone into road construction and maintenance.

2. Sugar Hill Perlite: T.45N., R. 14E., Sec. 26, M.D.B.M.

This cluster of rhyolite shallow intrusions provided the first commercial production in California during the mid-1940s. The material was used to manufacture light-weight concrete.

* Adapted in large part from Chesterman, 1956, 1957, and 1966.

3. Glass Mountain Pumice: (T.44N., R.4E. Sec. 27, M.D.B.M.)

This locality and Little Glass Mountain to the west are pumice and obsidian eruptions related to the Medicine Lake Caldera. The pumice represents some of the youngest Cascade volcanism, having been dated as no more than 1,100 years old (Chesterman, 1953). The pumice ranges in thickness from 1 foot furthest from the center of eruption to 60 feet close to the source. The pumice contains two distinct layers with a soil horizon at the top of the older layer. All of the mining has been confined to the top layer and enough of this material is present to last well into the next century. The material is marketed from Klamath Falls, Oregon and the San Francisco Bay Area. All of the production goes into structural concrete and concrete block.

Glass Mountain also has block pumice in two localities suitable for the manufacture of scouring blocks. Pumiceous obsidian is found scattered across the surface of the Glass Mountain obsidian flow. Pumice blocks have been mined from pumice breccia outcropping on the northwest side of the obsidian flow. To be useable, the pumice must be free of obsidian ribs, uniformly cellular and light in weight (Chesterman, 1956).

Little Glass Mountain to the west of Medicine Lake has mineable pumice deposits in an area of 16 square miles. The thickness of the deposits is unknown but is thick enough to have almost completely concealed the underlying basalt and andesite.

4. Clear Lake Pumice and Volcanic Cinders:
(T.13N., R.7W., Sec. 16 and 17, M.D.B.M.)

Pumice and volcanic cinders have been produced since the middle 1940's from vesiculated obsidian and pyroxene dacite one quarter-mile north of Clear Lake Park near State Highway 53. More recent production has come from a cinder cone north of State Highway 20, two miles east of Clearlake Oaks. The obsidian flows are vesiculated throughout, flow-banded, and contain scattered, rounded masses of black obsidian. Some of the vesiculated obsidian contains perlite. The pyroxene dacite cinders have been used as decorative rock and construction material.

5. Sonoma Volcanics Pumice: (T.6N., R.3W., Sec. 20, M.D.B.M.)

The north flank of Mount George has been an important pumice producer since 1932. Massive lapilli-tuff more than 100 feet thick consists of small fragments of pumice imbedded in a fine-grained, volcanic tuff. Most of the production has been used in concrete block.

6. St. Helena Perlite: (T.7N., R.5W., M.D.B.M.)

In an area about 3 miles southeast of St. Helena in Napa County, perlite occurs in late Tertiary flows which range in thickness from

a few feet to several tens of feet. The flows lie upon tuffs and conglomerates, and are overlain by flows of light-gray, vesicular dacite. All are exposed in broad northwest-trending folds. Locally, the overlying volcanic rocks have been eroded away and large bodies of perlite are now covered only by sandy soil. The perlite is dark-gray to light-gray and contains unevenly distributed phenocrysts of feldspar, quartz, and hypersthene. Concentrations of these minerals locally constitute as much as 20 percent of the volume of the rock (Chesterman, 1957).

7. Friant Pumice and Pumicite: (T.11S., R.20E., Sec. 1, M.D.B.M.)

The Friant formation of probable Pleistocene age crops out in the low hills to the north and east of Friant in Madera County. The unit is flat-lying and consists mostly of lake and stream-laid silt, sand, gravel, and pumicite. Pumice is present locally as thin beds or mixed with sand overlying the pumicite. Locally, the pumicite is at least 150 feet thick.

8. Mono Craters Pumice: (T.1N., R.27E., Sec. 19, M.D.B.M.)

The Mono Craters are a series of obsidian domes that extend southward from the shore of Mono Lake. Late Pleistocene in age, the domes rise abruptly from a plain covered with loose pumice ejecta. Panum Crater, the northernmost of the group, and Southern Coulee contain massive block pumice which is mined and sawed into scouring blocks at a plant in Lee Vining. The vesicles in the pumice are tubular and drawn out in the direction of flowage. Drilling has established that the massive pumice extends downward for several hundred feet before passing into vesicular obsidian.

9. Yellowjacket Spring Pumice:
(T.3S., R.32E., Sec. 6, M.D.B.M. and surrounding deposits)

Located southeast of Benton Hot Springs in Mono County, this district contains a number of stream-laid deposits of pumice. One-half mile south of Yellowjacket Spring, 60 feet of pumice is exposed in a stream bank. All of the exposures of pumice strike northward and dip eastward at 5° to 20°.

10. Blind Spring Valley Pumice:
(T.1S., R.31E., Sec. 25 and 26, M.D.B.M.)

This group of deposits extends 5 miles to the north and 3 miles to the south of Benton Hot Springs. The pumice has been deposited from the air and is discontinuous. The pumice is overlain by sandy, pumiceous soil and is best exposed in quarries and exploration trenches.

North of Benton Hot Springs, the pumice layers strike N.25-30°W. and dip 20°NE. About 2 miles south of Benton Hot Springs, the bedding strikes N.30°-35°E. and dips 7°-15°SE. Bedding is poorly developed in the pumice and in several places cannot be detected.

The pumice fragments range in color from light-gray to white. The white pumice has larger cells, lower bulk density and less crushing strength than the light-gray pumice.

11. Fish Springs Perlite: (T.10S., R.33E., Sec. 25, M.D.B.M.)

The Fish Springs perlite area is in western Inyo County, about 7 miles south of Big Pine. Here, a single perlite deposit forms a Recent volcanic dome which rises as a conspicuous hill about 200 feet high and is surrounded by outwash granitic debris derived from the east face of the nearby Sierra Nevada. The dome is elongated in an east-west direction and is capped by pumiceous perlite that grades downward into less pumiceous perlite. The zone of mineable perlite is about 80 feet thick and is underlain successively by brecciated obsidian in a pumiceous perlite matrix, and by a dense, glassy, perlitic-vitrophyre. The perlite is light-gray to white, medium to fine-grained, pumiceous, and contains local, small, rounded bodies of dark-gray and black obsidian (Chesterman, 1957).

12. Coso Range Pumice: (T.21S., R.37E., Sec. 13, M.D.B.M.)

The Coso Range is a north-tranading mountain range with a granitic-metamorphic core that is overlain by andesitic and basaltic lavas that contain beds of pumice and domes of perlite. The pumice is stream-laid, well-bedded, and separated from other pumice beds by gray sand. The pumice beds range in thickness from 1 to 15 feet but, locally, are as much as 100 feet thick. Angular boulders of granite, andesite, and mica schist are randomly scattered throughout the pumice.

The pumices in this area were formed by nuee ardente or glowing avalanche type of eruption. Chemical analysis of the pumice reveals that, unlike other pumice deposits in the Great Basin, these are andesitic in composition.

13. El Paso Mountains Pumice and Pumicite:
(T.28S., R.38E., Sec. 33, M.D.B.M.)

The Pliocene Ricardo formation is well exposed in this range and consists of continental and lacustrine sedimentary rocks containing tuffs and lava flows. Both pumice and pumicite have been mined in large quantities from the tuffs. A lapilli tuff located near the base of the Ricardo has an exposed thickness of 50 feet and can be traced laterally for at least 7 miles.

14. CALIFORNIA PRODUCTION

California production of pumice and pumicite was 59,000 short tons in 1983 and was valued at \$1,293,000. The only perlite production in the State was from the Fish Springs deposit in Inyo County.

15. UTILIZATION AND MARKETS

Pumice is used principally as aggregate in the production of light-weight concrete, and as an abrasive. Although some pumicite is used as a pozzolan in the production of concrete and as an abrasive, its principal usage is as a pesticide carrier for agricultural sprays. Although pozzolan has been successfully manufactured from pumice and pumicite, this market is dominated by diatomite and diatomaceous shale because these materials contain a higher percentage of silica.

About 40 percent of the perlite produced and expanded in the United States is used as aggregate in plaster. Other uses for expanded perlite include concrete aggregate, foundry sand, filter aid, filler, wallboard, and soil conditioning.

Volcanic cinders find their greatest use in highway and railroad building. Minor, yet substantial, amounts of volcanic cinders are used as aggregate in concrete building blocks, monolithic concrete construction, stucco, roofing granules, decorative stone in gardens, and as a conditioner of soils.

Up until recent years, expanded shale aggregate has been a major competitor for pumice in structural concrete. This competition has diminished and almost disappeared with the escalating cost of fuel. At the present time, almost no expanded shale is produced in California and pumice production has increased to fill this void.

16. MINING METHODS AND BENEFICIATION

All four commodities are mined by open-pit methods using heavy-duty diesel bulldozers, front-end loaders, or shovels. Crushing is necessary in some materials although many are fragmented during the process of eruption so that this is not necessary. Sizing on a vibrating screen produces a uniform product that can be directly added to a concrete mix.

Commercial perlite has an additional process in that it is expanded in a high-temperature furnace. The expanded perlite is then sized again and used to compound accoustical and insulating plasters and concretes.

17. CALIFORNIA EVENTS, TRENDS, AND ISSUES

The production of all of these materials is closely tied to the construction industry so increased building starts foretell production expansion. As expanded shale light-weight aggregate has become uneconomic in cost, pumice has also filled this void. A combination of these two factors indicates a bright future for California pumice, pumicite, perlite, and volcanic cinder.

Perlite has a slightly different market position because it is low in strength but extremely light in weight. Consumption has increased in hydroponics, the art of growing food in a granular, soil-free, water-saturated medium. Both expanded perlite and expanded vermiculite are currently being used as a hydroponic medium.

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